Incidence of Pathogenic Staphylococci in a Group of Northern Ireland Munition Workers

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DURING the winter of 1939-40 a number of men working in a munition factory attended at the skin department of the Royal Victoria Hospital, Belfast, where they were seen by Dr. Ivan McCaw.

They were suffering from staphylococcal lesions of the skin of the arms and thighs, which varied in severity from mild folliculitis with acne to severe boils. During work, the skin of the parts affected was in continuous contact with mineral oil and the clothing of the men examined was soaked with oil.

Since it has been shown by Hart (1937), Hallman (1937), McFarlane (1938), and others that carriers of pathogenic staphylococci are relatively common in groups of normal persons, an investigation was begun somewhat on the lines of that carried out by Gillespie, Devenish, and Cowan (1939) to determine the carrier-rate among the men exposed to oil, and if possible to discover the reason for the high incidence of skin lesions among these workers.

Cultures were made from the nasal cavities, normal skin, and any existing lesion, whether slight or severe. The swabs were planted on blood-agar, incubated at 37°C. for twenty-four hours, and then kept under observation from four to seven days on the bench. Likely colonies of creamy or golden colour were picked off for investigation, and if no creamy colonies were present, white colonies were taken instead. In all the colonies selected the presence or absence of hæmolysis on blood-agar was noted.

Three hundred and sixty-three strains were isolated and studied. They were tested for their ability to ferment mannite and to coagulate human plasma. Most strains were also tested for the presence of alpha hæmolysin. These tests were carried out according to the methods described by Gillespie, Devenish, and Cowan (1939) in their investigation on a group of medical students attending University College Hospital, London.

Since it has been established by Cruickshank (1937), Chapman et al. (1938), and Gillespie, Devenish, and Cowan (1939), that the presence of coagulase is a reliable criterion for the pathogenicity of staphylococci, the test for this substance was used to determine the pathogenicity of the strains investigated.

In biological properties, the results attained were similar to those published by Gillespie, Devenish, and Cowan (1939). One albus strain of nasal origin gave a positive coagulase test, and so may be regarded as a potential pathogen. Devenish and Miles (1939) classified coagulase positive albus strains in the aureus group.

Eighty-two men submitted themselves for examination. Their ages ranged from 15 to 62 years, but most were 19 to 20 years old.

TABLE I.

	No.	Percentage Nasal-carriers.	Percentage Skin-carriers.	Percentage of both Nasal- and Skin-carriers.	Total Percentage of Carriers.	Percentage of Persons with Staphylococcal Lesions at some time.
Students U.C.H. ...	159	43.4	19.5	13	50	41
Munition Workers N.I. ...	82	21.9	20.7	6	50	75

The results are seen in table I, and are there compared with those of Gillespie, Devenish, and Cowan (1939). The percentage of nasal-carriers (21.9) is much less in the Northern Ireland group, and the percentage of skin-carriers (20.7) is approximately the same in both groups. The total percentage of persons carrying pathogenic staphylococci is also the same in both groups (50), but there is a striking difference between the groups in that the percentage of persons who had had active staphylococcal lesions was much higher in the Northern Ireland group than in the U.C.H. group.

TABLE II.

Type of Lesion.	No.	Percentage Nasal-carriers	Percentage Skin-carriers	Total Percentage of Carriers
None	20	25	15	40
Mild folliculitis or pustules ...	46	19.5	19.5	50
Boils	16	25	18.7	75

The relationship of skin-carrier rate to nasal-carrier rate is given in table II. For comparison, the figures given by Gillespie, Devenish, and Cowan (1939) in the U.C.H. group are included in the table. This shows that the percentage of persons carrying pathogenic staphylococci in both nose and skin is almost identical in the two groups. In the Northern Ireland group, however, a higher percentage of those who are free from staphylococcal infection of the nose are skin-carriers of potentially pathogenic staphylococci.

TABLE III.

Nasal-carriers		Skin-carriers		Percentage
	No.	+	−	Positive
	69	20	49	29.0
+ ...	*18*	*5*	*13*	*28.7*
	90	11	79	12.2
— ...	*64*	*12*	*52*	*18.7*
	159	31	128	19.5
Total ...	*82*	*17*	*65*	*20.7*

The figures in italics refer to the group of Munition Workers N.I.

The relationship between the carrier - rates and the presence and severity of infection is shown in table III. The types of lesion were classified as "None," "Mild Folliculitis or Pustules," and "Boils." In the "Mild" group the infection of the skin was superficial, while in the group with "Boils" there was a definite and usually severe type of infection. The results obtained show that the percentage

of carriers in nose and skin combined was greatest in the group of men suffering from boils, and least in those who had no lesions.

Since seventy-five per cent. of the Northern Ireland group had had at some time a staphylococcal infection, as compared with forty-one per cent. in U.C.H. students, it is evident that some factor other than the carrier-rate must be concerned in the production of lesions. The most obvious were the lack of personal cleanliness among the men examined, and the oiliness of the skin and clothes. Almost all the men were dirty both in their persons and clothes, while lack of ordinary cleanliness existed apart from the oiliness. They seldom bathed, and it was evident that their clothes were not washed often enough. As a result, in practically all of the men who were exposed to oil during work, the skin was covered with a film of oil continuously. The mechanical effect of this was to cause blocking of the sweat-ducts and to prevent the removal of organisms by sweating or friction.

Samples of the machine-oil used were examined bacteriologically, and were found to be sterile. An experiment to determine whether staphylococci could live in the oil was carried out. Inocula of 500 million, 50 million, 5 million, and 500,000 organisms per c.c. of oil were made and kept at room temperature. Subcultures on ordinary agar were made from the oil immediately after inoculation and after twenty-four, forty-eight, and ninety-six hours and at intervals up to seventeen days. Growth was obtained from the sub-cultures made immediately after the oil was inoculated. In twenty-four hours the oil which had had an inoculation of 500,000 cocci was sterile, and in forty-eight hours all samples of oil except that containing 500 million cocci were sterile. After seventeen days, that sample of oil containing 500 million cocci per c.c. was still capable of producing a good growth. Sub-cultures from controls on ordinary broth all gave good growth after seventeen days observation, except that with the 500,000 inoculum, which was then sterile. It is therefore possible that infection could be spread by means of the oil, but since no micro-organisms of any kind were obtained from the specimens taken from the machinery, it is unlikely that the oil acted as a vehicle for the spread of the organisms.

Summary.

The results of the investigation show that the total carrier-rate was the same in the Northern Ireland munition workers as in the U.C.H. students (i.e., 50 per cent.), but that the proportion of skin-carriers to nasal-carriers was increased in the Northern Ireland group. This was due to the fact that, although the skin-carrier rate was approximately the same in both groups, the nasal-carrier rate in the N.I. group (21.9 per cent.) was about half that found in the U.C.H. students (43.4 per cent.).

The high incidence of skin infections in the group described is probably due to the high incidence of potentially pathogenic staphylococci on the workers' skin, aggravated by lack of personal cleanliness and by the mechanical effect of the presence of a constant film of machine oil.

Results obtained from the bacteriological examination of the oil show that it is unlikely that it acts as a vehicle of infection.

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Studies from the Institute of Pathology

A CASE OF DIPHTHERIA

CASE XI—A3054.

CLINICAL HISTORY.

THE patient, a boy of 13 years, had had pain and swelling in the throat for about three days. This was thought to be mumps. He had also a "septic" finger. The advice of a chemist was sought, and treatment was advised. Later a medical practitioner who was summoned in haste could only pronounce life extinct.

POST-MORTEM.

The body is that of a male child of normal development for the age given. Subcutaneous fat is rather scanty, but the skin is clean and there is no evidence of ill-treatment or neglect. There is an insignificant paronychial infection of one finger of the left hand. Oedema and abnormal pigmentation are absent. Lymph-glands in the axillæ, groins, and neck are not palpable. The neck is greatly swollen, and on incising it, considerable quantities of œdema fluid pour from the subcutaneous tissues and from between the fascial planes. Rigor mortis is established, and post-mortem lividity is normally distributed.

Serous cavities.—The right pleural cavity is obliterated by dense fine adhesions. The left contains only a slight excess of clear yellow fluid. The pericardial sac is normal, and there is no excess of free fluid and no adhesions in the peritoneal cavity. Only a few petechial hæmorrhages are visible beneath any of the serosa.

Left lung.—This is uniformly congested throughout. In the middle of the upper lobe, situated well below the pleura, there is a circular area of caseation almost 1 cm. in diameter. It is closely related to a much smaller but better calcified area slightly nearer the pleura. No satellite tubercles are visible. Changes in the hilar lymph-glands are not evident.

Right lung.—A small and entirely calcified nodule is present in the upper lobe. No lesion, old or recent, can be demonstrated in relation to the pleura, which is